

09/936,692

2

In the claims:

1. (Currently Amended) ~~An ionomer composite composition~~ A compomer having improved physical properties, the ~~composite~~ compomer consisting essentially of:  
a glass material containing divalent cations, multivalent cations, or combinations thereof;  
and

at least one copolymer, comprising:

at least one hydrophilic monomer containing acid functional groups adapted to react with the divalent cations, multivalent cations, or mixtures thereof to form ionic crosslinks among polymer chains, the hydrophilic monomer present in an amount sufficient to impart a desired degree of aqueous solubility to the copolymer, the hydrophilic monomer amount ranging from about 1% to about 25% of the copolymer; and

at least one hydrophobic monomer present in an amount sufficient to impart a desired degree of structural stability to the ~~composite composition~~ compomer when exposed to an aqueous environment, the hydrophobic monomer amount ranging from about 75% to about 99% of the copolymer.

2. (Currently Amended) The ionomer composite composition as defined in claim 1, wherein the glass material further contains fluoride, and wherein the composite composition provides fluoride release.

3. (Currently Amended) The ionomer composite composition as defined in claim 1, wherein the glass material is selected from the group consisting of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{AlF}_3$ ,  $\text{CaF}_2$ ,  $\text{NaF}$ ,  $\text{Na}_3\text{AlF}_6$ ,  $\text{AlPO}_4$ , and mixtures thereof.

4. (Currently Amended) The ionomer composite composition as defined in claim 1, wherein a weight ratio of glass material to copolymer ranges from about 10:90 to about 90:10.

5. (Previously Presented) The ionomer composite composition as defined in claim 4, wherein the weight ratio of glass material to copolymer ranges from about 40:60 to about 85:15.

09/936,692

3

6. (Currently Amended) The ionomer composite composition as defined in claim + 12 wherein the at least one hydrophilic monomer is a monomer containing unsaturated carboxylic acid.

7. (Previously Presented) The ionomer composite composition as defined in claim 6 wherein the unsaturated carboxylic acid is selected from the group consisting of: acrylic acid, methacrylic acid, 4-vinylbenzoic acid, crotonic acid, oleic acid, elaidic acid, itaconic acid, maleic acid, fumaric acid, acetylenedcarboxylic acid, tricarbollylic acid, sorbic acid, linoleic acid, linolenic acid, eicosapentenoic acid, anhydrides of the acids, and mixtures thereof.

8. (Previously Presented) The ionomer composite composition as defined in claim 7 wherein the hydrophilic monomer is selected from the group consisting of organic acids having at least one of sulfonic acid and phosphonic acid replacement of the carboxyl group of the unsaturated carboxylic acids, and mixtures thereof.

9. (Currently Amended) The ionomer composite composition as defined in claim + 12 wherein the at least one hydrophobic monomer is unsaturated.

10. (Previously Presented) The ionomer composite composition as defined in claim 9 wherein the at least one hydrophobic monomer is selected from the group consisting of acrylates, methacrylates, ethylenes, propylenes, tetra-fluoroethylene, styrenes, vinyl chloride, vinylidene chloride, vinyl acetate, acrylonitrile, 2,2-bis[4-(2-hydroxy-3-methacryloyloxy-propyloxy)-phenyl] propane (Bis-GMA), ethyleneglycol dimethacrylate (EGDMA), tri-ethyleneglycol dimethacrylate (TEGDMA), bis(2-methacryly-oxyethyl) ester of isophthalic acid (MEI), bis(2-methacrylyoxyethyl) ester of terephthalic acid (MET), bis(2-methacrylyoxyethyl) ester of phthalic acid (MEP), 2,2-bis(4-methacryloyloxy phenyl) propane (BisMA), 2,2-bis[4-(2-methacryloyloxyethoxy) phenyl] propane (BisEMA), 2,2-bis[4-(3-methacryloyloxy-propoxy) phenyl] propane (BisPMA), hexafluoro-1,5-pentanediol dimethacrylate (HFPDMA), bis-(2-methacryloyloxyethoxy-hexafluoro-2-propyl) benzene [Bis(MEHFP) $\phi$ ], 1,6-bis(methacryloyloxy-2-ethoxycarbonylamino)-2,4,4-trimethylhexane (UEDMA), spiro orthocarbonates, and mixtures thereof.

09/936,692

4

11. (Currently Amended) The ionomer composite composition as defined in claim + 12 wherein a ratio of the hydrophilic monomer to the hydrophobic monomer is from about 1:99 to about 20:80.

12. (Currently Amended) An ionomer composite composition having improved physical properties, the composite consisting essentially of:

a glass material containing divalent cations, multivalent cations, or combinations thereof;  
and

at least one copolymer, comprising:

at least one hydrophilic monomer containing acid functional groups adapted to react with the divalent cations, multivalent cations, or mixtures thereof to form ionic crosslinks among polymer chains, the hydrophilic monomer present in an amount sufficient to impart a desired degree of aqueous solubility to the copolymer, the hydrophilic monomer amount ranging from about 1% to about 25% of the copolymer; and

at least one hydrophobic monomer present in an amount sufficient to impart a desired degree of structural stability to the composite composition when exposed to an aqueous environment, the hydrophobic monomer amount ranging from about 75% to about 99% of the copolymer;

The ionomer composite composition as defined in claim 1 wherein the at least one copolymer is selected from the group consisting of poly(methyl methacrylate-methacrylic acid), poly(methyl acrylate-acrylic acid), poly(methyl methacrylate-acrylic acid), poly(ethyl acrylate-acrylic acid), poly(ethyl methacrylate-methacrylic acid), poly(butyl acrylate-acrylic acid), poly(ethylene-acrylic acid), poly(ethylene-methacrylic acid), poly(acrylonitrile-maleic anhydride), poly(butadiene-acrylonitrile-acrylic acid), poly(butadiene-maleic acid), poly(butadiene-maleic anhydride), poly(propylene-acrylic acid), poly(propylene-ethylene-acrylic acid), poly(vinyl chloride-vinyl acetate-maleic acid), and mixtures thereof.

13. (Currently Amended) The ionomer composite composition as defined in claim + 12 wherein the composite further includes as a minor constituent a polymer selected from the group consisting of PMMA, polycarbonates, polyethylenes, polyamides, PEEK polymers, epoxies, and mixtures thereof.

14. (Original) The ionomer composite composition as defined in claim 2 wherein the composite further includes a minor constituent selected from the group consisting of pigments, surfactants, adhesion enhancers, fluoride releasing enhancers, bioactive agents, and mixtures thereof.

15. (Original) The ionomer composite composition as defined in claim 2 wherein the glass material consists of 25.10 wt% SiO<sub>2</sub>, 37.45 wt% Al<sub>2</sub>O<sub>3</sub>, and 37.45 wt% CaF<sub>2</sub>.

16. (Currently Amended) An ionomer composite composition having improved physical properties, the composite consisting essentially of:

a glass material containing divalent cations, multivalent cations, or combinations thereof;  
and

at least one copolymer, comprising:

at least one hydrophilic monomer containing acid functional groups adapted to react with the divalent cations, multivalent cations, or mixtures thereof to form ionic crosslinks among polymer chains, the hydrophilic monomer present in an amount sufficient to impart a desired degree of aqueous solubility to the copolymer, the hydrophilic monomer amount ranging from about 1% to about 25% of the copolymer; and

at least one hydrophobic monomer present in an amount sufficient to impart a desired degree of structural stability to the composite composition when exposed to an aqueous environment, the hydrophobic monomer amount ranging from about 75% to about 99% of the copolymer;

The ionomer composite composition as defined in claim 1 wherein the at least one copolymer is poly(methyl methacrylate-co-methacrylic acid) (PMMA-MAA).

17. (Original) The ionomer composite composition as defined in claim 16 wherein the ratio of PMMA to MAA is 80:20.

09/936,692

6

18. (Currently Amended) ~~An ionomer composite composition~~ A compomer having improved physical properties and useful for dental applications, the ~~composite compomer~~ consisting essentially of:

a glass material containing divalent cations, multivalent cations, or combinations thereof; and

at least one copolymer, comprising:

at least one hydrophilic monomer containing acid functional groups adapted to react with the divalent cations, multivalent cations, or combinations thereof to form ionic crosslinks among polymer chains, the hydrophilic monomer present in an amount sufficient to impart a desired degree of aqueous solubility to the copolymer, the hydrophilic monomer amount ranging from about 1% to about 25% of the copolymer; and

at least one hydrophobic monomer present in an amount sufficient to impart a desired degree of structural stability to the ~~composite composition~~ compomer when exposed to an aqueous environment, the hydrophobic monomer amount ranging from about 75% to about 99% of the copolymer;

wherein the ~~composite composition~~ compomer is adaptable for use in substantially water insoluble dental applications.

19. (Currently Amended) The ionomer composite composition as defined in claim 1826 wherein the glass material further contains fluoride, and wherein the composite composition provides fluoride release.

20. (Original) The ionomer composite composition as defined in claim 19 wherein the glass material is selected from the group consisting of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{AlF}_3$ ,  $\text{CaF}_2$ ,  $\text{NaF}$ ,  $\text{Na}_3\text{AlF}_6$ ,  $\text{AlPO}_4$ , and mixtures thereof.

21. (Previously Presented) The ionomer composite composition as defined in claim 20 wherein the weight ratio of glass material to copolymer ranges from about 40:60 to about 85:15.

22. (Previously Presented) The ionomer composite composition as defined in claim 21 wherein the at least one hydrophilic monomer is an unsaturated carboxylic acid selected from the

09/936,692

7

group consisting of: acrylic acid, methacrylic acid, 4-vinylbenzoic acid, crotonic acid, oleic acid, elaidic acid, itaconic acid, maleic acid, fumaric acid, acetylenedicarboxylic acid, tricarballylic acid, sorbic acid, linoleic acid, linolenic acid, eicosapentenoic acid, anhydrides of the acids, and mixtures thereof.

23. (Previously Presented) The ionomer composite composition as defined in claim 22 wherein the at least one hydrophilic monomer is selected from the group consisting of organic acids having at least one of sulfonic acid and phosphonic acid replacement of the carboxyl group of the unsaturated carboxylic acids, and mixtures thereof.

24. (Previously Presented) The ionomer composite composition as defined in claim 22 wherein the at least one hydrophobic monomer is unsaturated and is selected from the group consisting of acrylates, methacrylates, ethylenes, propylenes, tetra-fluoroethylene, styrenes, vinyl chloride, vinylidene chloride, vinyl acetate, acrylonitrile, 2,2-bis[4-(2-hydroxy-3-methacryloyloxy-propoxy)-phenyl] propane (Bis-GMA), ethyleneglycol dimethacrylate (EGDMA), tri-ethyleneglycol dimethacrylate (TEGDMA), bis(2-methacryly-oxyethyl) ester of isophthalic acid (MEI), bis(2-meth-acrylyoxyethyl) ester of terephthalic acid (MET), bis(2-methacrylyoxyethyl) ester of phthalic acid (MEP), 2,2-bis(4-methacrylyoxy phenyl) propane (BisMA), 2,2-bis[4-(2-methacrylyoxyethoxy) phenyl] propane (BisEMA), 2,2-bis[4-(3-methacrylyoxy-propoxy) phenyl] propane (BisPMA), hexafluoro-1,5-pentanediol dimethacrylate (HFPDMA), bis-(2-methacrylyoxyethoxy-hexafluoro-2-propyl) benzene [Bis(MEHFP) $\phi$ ], 1,6-bis(methacrylyoxy-2-ethoxycarbonylamino)-2,4,4-tri-methylhexane (UEDMA), spiro orthocarbonates, and mixtures thereof.

25. (Previously Presented) The ionomer composite composition as defined in claim 24 wherein a ratio of the hydrophilic monomer to the hydrophobic monomer is from about 5:95 to about 20:80.

26. (Currently Amended) An ionomer composite composition having improved physical properties and useful for dental applications, the composite consisting essentially of:

09/936,692

8

a glass material containing divalent cations, multivalent cations, or combinations thereof;  
and

at least one copolymer, comprising:

at least one hydrophilic monomer containing acid functional groups adapted to react with the divalent cations, multivalent cations, or combinations thereof to form ionic crosslinks among polymer chains, the hydrophilic monomer present in an amount sufficient to impart a desired degree of aqueous solubility to the copolymer, the hydrophilic monomer amount ranging from about 1% to about 25% of the copolymer; and

at least one hydrophobic monomer present in an amount sufficient to impart a desired degree of structural stability to the composite composition when exposed to an aqueous environment, the hydrophobic monomer amount ranging from about 75% to about 99% of the copolymer;

wherein the composite composition is adaptable for use in substantially water insoluble dental applications;

and The ionomer composite composition as defined in claim 18 wherein the at least one copolymer is selected from the group consisting of poly(methyl methacrylate-methacrylic acid), poly(methyl acrylate-acrylic acid), poly(methyl methacrylate-acrylic acid), poly(ethyl acrylate-acrylic acid), poly(ethyl methacrylate-methacrylic acid), poly(butyl acrylate-acrylic acid), poly(ethylene-acrylic acid), poly(ethylene-methacrylic acid), poly(acrylonitrile-maleic anhydride), poly(butadiene-acrylonitrile-acrylic acid), poly(butadiene-maleic acid), poly(butadiene-maleic anhydride), poly(propylene-acrylic acid), poly(propylene-ethylene-acrylic acid), poly(vinyl chloride-vinyl acetate-maleic acid), and mixtures thereof.

27. (Currently Amended) The ionomer composite composition as defined in claim 18, wherein the composite further includes as a minor constituent a polymer selected from the group consisting of PMMA, polycarbonates, polyethylenes, polyamides, PEEK polymers, epoxies, and mixtures thereof.

28. (Original) The ionomer composite composition as defined in claim 19 wherein the composite further includes a minor constituent selected from the group consisting of pigments,

09/936,692

9

surfactants, adhesion enhancers, fluoride releasing enhancers, bioactive agents, and mixtures thereof.

29. (Original) The ionomer composite composition as defined in claim 19 wherein the glass material consists of 25.10 wt% SiO<sub>2</sub>, 37.45 wt% Al<sub>2</sub>O<sub>3</sub>, and 37.45 wt% CaF<sub>2</sub>.

30. (Currently Amended) An ionomer composite composition having improved physical properties and useful for dental applications, the composite consisting essentially of:

a glass material containing divalent cations, multivalent cations, or combinations thereof;  
and

at least one copolymer, comprising:

at least one hydrophilic monomer containing acid functional groups adapted to react with the divalent cations, multivalent cations, or combinations thereof to form ionic crosslinks among polymer chains, the hydrophilic monomer present in an amount sufficient to impart a desired degree of aqueous solubility to the copolymer, the hydrophilic monomer amount ranging from about 1% to about 25% of the copolymer; and

at least one hydrophobic monomer present in an amount sufficient to impart a desired degree of structural stability to the composite composition when exposed to an aqueous environment, the hydrophobic monomer amount ranging from about 75% to about 99% of the copolymer;

wherein the composite composition is adaptable for use in substantially water insoluble dental applications;

wherein the glass material further contains fluoride, and wherein the composite composition provides fluoride release;

and The ionomer composite composition as defined in claim 19 wherein the at least one copolymer is poly(methyl methacrylate-co-methacrylic acid) (PMMA-MAA).

31. (Original) The ionomer composite composition as defined in claim 30 wherein the ratio of PMMA to MAA is 80:20.